Central Asian University of Environmental and Climate Change Studies
GREEN UNIVERSITY
Sustainable Development Faculty

Master's thesis: Title: "Assessing the Economic and Environmental Implications of the Carbon Border Adjustment Mechanism (CBAM) for Uzbekistan"

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DECLARATION

I, Elbek Shomuratov, here confirm that this master's thesis with title "Assessing the Economic and Environmental Implications of the Carbon Border Adjustment Mechanism (CBAM) for Uzbekistan" is my own work and not submitted previously, in whole or in part, for the award of any degree or diploma at this or any other institution.

All sources of information utilized in the thesis have been appropriately credited in form of relevant citations and references.

I therefore claim that the work conforms with standards of academics and codes of ethics of the Central Asian University of Environmental and Climate Change Studies.

I fully understand that any miscalculations or misinterpretations within the work are my sole responsibility, and I will gladly accept and implement any necessary corrections if identified.

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ABSTRACT

The European Union's shift to climate neutrality via its Green Deal has introduced new trade policies, the Carbon Border Adjustment Mechanism (CBAM) among them. The mechanism will impose a carbon price on certain imports into the EU, focusing on high-emitting-producing countries. This thesis examines how Uzbekistan can theoretically be impacted by CBAM, a country with increasing trade relationships with the EU and massive dependence on carbon-emitting industries such as cement, steel, aluminum, and fertilizers.

From a combination of quantitative data analysis and qualitative stakeholder interviews from government agencies to business analysts, the research examines the prospective risks along with the game-changing opportunities of CBAM. In the short term, the Uzbek exporters may feel increases in costs and competitiveness issues. But the system can also be an inducer of industrial modernization, carbon reduction, and development of environmental reforms.

Research places emphasis on global cooperation and technical assistance. Helpful data of GIZ and Green Economy Projects in the Ministry of Economy and Finance shows how policy support, finance tools, and institutional capacity building can position Uzbekistan in a position to better prepare to respond appropriately to CBAM.

As a whole, the findings show that not only is CBAM challenging to Uzbekistan but also an opportunity to become part of the world's sustainability agenda and build a more climate-resilient economy. Provided with a proper strategy, investment, and cooperation, Uzbekistan can potentially turn this policy shift into a development opportunity.

Keywords: CBAM, Uzbekistan, EU Green Deal, decarbonization, sustainable development

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SECTION 1. INTRODUCTION

General information:

Over the last few decades, climate change has been one of the most controversial global issues and an international priority to the global community. Carbon dioxide (CO_2), the leading driver of global warming, is at the heart of the problem and is in dire need of emissions reduction. In this effort, the European Union (EU) has led the way in the world on climate policy with its enactment of a sequence of policies aimed at making the EU carbon neutral by 2050.

One of the EU's most powerful tools against climate change—and to make the shift to a low-carbon economy—is the Carbon Border Adjustment Mechanism (CBAM).

Signed into law under EU Regulation 2023/956 and officially launched on October 1, 2023 (EU Regulation), the CBAM is the EU's answer to the issue of carbon leakage—when companies relocate carbon-emitting manufacturing to nations with weaker climate laws. It supplements the EU Emissions Trading System (EU ETS), which adds a cost for carbon emissions within the EU.

One element of the entire European Green Deal, the CBAM has as its intention to have the price of certain imported goods pay for their hidden-in-them carbon emissions. The policy will be used to level the playing field for European producers, who are subject to extra costs due to stricter climate policy, and drive businesses in other countries to adopt more ambitious climate policies (European Commission).

The EU ETS is EU’s flagship market-based policy to reduce the emissions from producers in certain high-emitting industries (European Commission, 2025). It covers heat and power generation, energy-intensive industries, (domestic) aviation and maritime transport, which together account for around 40% of total EU emissions. It is set up as a cap-and-trade system of emission allowances,

where one allowance allows a producer to emit one metric tonne of carbon dioxide (CO_2) or its equivalent in other greenhouse gases (GHGs). A cap is set on the total number of emission allowances in circulation, thereby limiting the total amount of emissions from producers covered by the EU ETS. This gap will be gradually reduced in line with the EU's decarbonisation targets. In addition, any allowances not used in a given year are cancelled, ensuring a steady reduction in the supply of allowances.

However, in certain industries open to trade, the increase in production costs associated with the need to purchase ETS allowances could lead companies to relocate production to other countries with less stringent climate policies – a phenomenon known as carbon leakage. Currently, to prevent carbon leakage, a limited number of ETS allowances are distributed to all producers in the industries with a high risk of carbon leakage free of charge. The number of allowances each producer receives is based on product benchmarks, which are calculated as the average emissions of the 10% most efficient producers of that product (European Commission, 2025). There are 54 product benchmarks in total. Beyond the reduction in free allowances due to efficiency gains by ETS producers, the number of free allowances is reduced by a linear reduction factor, set at 2.2% per year for the current ETS phase (2021 to 2030). If a producer needs more allowances than it has received for free, it must buy additional allowances either through auctions on the European Energy Exchange (EEX) or on the secondary market. The price of ETS allowances is therefore determined by the supply of allowances (limited by the cap) and the market demand.

The disadvantage of free allocation is that it weakens the price signals of the EU ETS and thus the incentives for producers to invest in decarbonisation, thereby limiting the effectiveness of the system. As an alternative option, CBAM has been introduced as an anti-carbon leakage mechanism that will allow free allocation in the EU ETS to be phased out. By applying the same carbon price to all EU supplies of certain goods, whether domestically produced or imported, it tackles

the incentive for EU producers to set up production in third countries with the aim of re-importing these goods into the EU while avoiding the carbon price. As a by-product, the EU also hopes to encourage decarbonisation efforts in third countries. In its current form, the CBAM only covers a subset of products that receive free allocation in the EU ETS. These include cement, nitrogenous fertilisers, iron and steel, aluminium, and hydrogen, as listed in Annex I of the CBAM Regulation. In addition, electricity is also included in the CBAM, for which there is already no free allocation under the EU ETS. The inclusion of Electricity is particularly important for developing countries.

CBAM covers both direct emissions from the production of CBAM goods (scope 1) and indirect emissions from the use of electricity for their production (scope 2) for cement and fertilisers, but currently only scope 1 emissions for iron and steel, aluminium, and hydrogen. In addition to CO2, CBAM also covers nitrous oxide (N2O) from fertiliser production and perfluorocarbons (PFCs) from aluminium production.

Sector	GHG scope	GHGs covered	Emission calculation
Iron & steel	Scope 1	CO_2	1. Actual reported emissions 2. Country-product specific defaults 3. Product-specific EU defaults*
Aluminum	Scope 1	CO_2, PCF_S	
Nitrous fertilizers	Scope 1&2	CO_2, N_20	
Cement	Scope 1&2	CO_2, N_20	
Hydrogen	Scope 1	CO_2	
Electricity	Scope 1	CO_2	Country-specific defaults Actual reported emissions possible if a set of criteria is met

Source: DIW Econ consulting company

Since its introduction, the CBAM has been raising the alarm—particularly among developing countries with carbon-based economies. Early estimates were sounding warning bells on negative impacts on exports, economic performance, and employment (Skalamera, 2024; World Bank, 2022). However, current research, including a report by the Asian Development Bank (ADB, 2023),

suggests that any cumulative economic impact will be limited to a few sectors in some nations.

However, most research focuses too narrowly, with much of the attention going to the percentage of CBAM-covered products in GDP or exports to the EU, with little regard for how emissions embedded within them are priced, nor the shape of impacted industries.

This paper aims to present a more holistic approach. It presents a model for assessing how CBAM might impact Uzbekistan—examining the state of preparedness of the country, its requirement level, and potential channels for support. The model will be applied specifically to the Uzbekistan case.

Aim and Objectives:

The aim of the research is to assess the Economic and Environmental Implications of the Carbon Border Adjustment Mechanism (CBAM) for Uzbekistan.

The specific objectives are:

1. Identify industries of Uzbekistan economy that are affected by CBAM
2. Evaluate contribution of CBAM to identified industries.
3. Analyze the effects of CBAM implementation on profit-oriented process and environmentally friendly manufacturing.
4. Identify the challenges and opportunities of implementing CBAM.

The specific questions are:

1. Which industry of Uzbek economy is / are affected by CBAM and in what amount?
2. What is the effect of CBAM implementation on profit-oriented production process and environmentally friendly manufacturing?
3. What are challenges and opportunities in implementing CBAM?

The purpose statement:

I decided to explore this topic because of how Uzbekistan is changing. The country's economy is still growing, and a big part of its industry relies on processes that release a lot of carbon. But there's a growing awareness here—people are starting to realize that climate issues can't be ignored. At the same time, industries are trying to modernize, and this shift brings both challenges and chances to improve. One of the reasons this transition matters is Uzbekistan's relationship with the European Union. Businesses here are increasingly looking toward the EU as a market, especially with all the recent global changes affecting trade. Sectors like chemicals, metals, and textiles see Europe as a promising destination for exports.

The EU isn't just any market—it's one of Uzbekistan's biggest trade partners. In 2024, trade between the two reached over $6 billion. What's interesting is that exports from Uzbekistan to the EU went up sharply, while imports stayed about the same. That shift shows how local industries are beginning to depend more on Europe, particularly in areas like fertilizer, copper, and fabrics. But at the same time, there's a move away from relying on EU imports, as companies turn to Asian suppliers instead. This growing trade with the EU is important for a few reasons. It helps keep people employed in factories, brings in foreign income, and pushes companies to produce better-quality goods. Plus, Uzbekistan has access to tariff benefits under something called the GSP+ program. These benefits could be even more useful if industries go greener and meet higher environmental standards.

But here's where it gets tricky. The EU is introducing stricter climate-related rules—one of the most important is the Carbon Border Adjustment Mechanism, or CBAM. If Uzbek companies want to keep exporting to Europe, they'll need to adjust how they operate. That means cleaner production, better energy use, and less pollution. It's a huge shift, especially for industries that were built in the Soviet era and still rely on outdated, energy-hungry equipment.

Uzbekistan has committed to several international climate agreements, including the Paris Agreement. There are plans to cut emissions and invest in greener production. But actually making that happen across the country's industries won't be easy. There are real economic risks involved, especially for companies that might struggle to keep up.

My goal in this thesis is to understand how CBAM might affect Uzbekistan—economically and environmentally. I want to explore not just the potential impacts, but also what steps the country could take in response. I'm also interested in looking at different future scenarios to see how we might overcome the toughest parts of this transition

SECTION 2. LITERATURE REVIEW

Theoretical Foundations of CBAM

The multiplying impacts of climate change and global warming have pushed the world community to adopt ambitious carbon emissions reduction policies. Decarbonization of all sectors globally has become a prime agenda. Policy instruments putting a price tag on carbon, like the Carbon Border Adjustment Mechanism (CBAM) of the European Union, have been instituted in this regard. The CBAM has its foundations in the EU Green Deal and seeks to link economic activity and environmental ambition through the application of a carbon price to imports into the EU of certain products from third countries. This seeks to prevent carbon leakage and apply the same carbon costs to importers as to EU producers. This literature review reflects on the consequences of CBAM for developing countries with regard to their own economic models, institutional strength, and vulnerability to the climate. Drawing upon a range of theoretical perspectives, it critically examines the environmental, economic, social, and governance impacts of CBAM and explores adaptive responses and policy implications.

The method is intellectually rooted in the writings of Arthur Cecil Pigou in the early 20th century. Pigou maintained in The Economics of Welfare (1920) that

market forces do not necessarily include all social costs, or gains, of consumption and production in the case of externalities—third-party costs or benefits. Through pollution, the producers can emit greenhouse gases (GHGs) without being subjected to the real cost of damage they cause the environment. This results in market inefficiency as well as excess production of unwanted goods. This market failure calls for government intervention through taxation or regulation so that private incentives are made consistent with social welfare.

CBAM implements Pigouvian logic globally by imposing a carbon price on EU imports based on greenhouse gas emissions inherent in production. The policy aims to put EU domestic producers, which are covered by the EU Emissions Trading System (ETS), on an equal footing with foreign exporters, the majority of which are established in low- or no-carbon pricing nations. By levying a fee on importers amounting to the exporting nation's national carbon price minus the ETS price, CBAM is intended to "internalize" the cost of carbon in trade streams. It has a two-pronged effect: it shields EU industrial competitiveness and creates a monetary incentive for production countries to cut carbon emissions from processes.

In the lexicon of economic theory, CBAM refers to a second-best policy if there is no internationally agreed climate policy or global carbon tax. It tries to combat "carbon leakage"—the phenomenon whereby businesses relocate to countries with more relaxed environmental regulations—by levelling the carbon charges at the border. For all theoretical merits, though, the use of CBAM poses grave questions of equity, fair trade, and the pattern of development of emerging economies.

Greenhouse gas (GHG) emissions can be reduced through a variety of regulatory approaches, which include both price-based and non-price-based instruments (Haites, 2018). Among these, price-based tools are gaining traction due to their clear and immediate influence on curbing emissions (Krause & Obeiter, 2015). These financial instruments also have the added benefit of generating government

revenue, which can be redirected toward climate-focused initiatives, such as investing in environmentally friendly technologies (Kennedy, Obeiter, & Kaufman, 2015).

Carbon pricing generally takes one of two main forms. The first is a carbon tax, where companies pay a set fee for every ton of carbon dioxide they emit. The second is an Emissions Trading System (ETS), where governments cap the total amount of emissions allowed and let companies trade emission permits depending on their needs. These tools have gained traction over the last 20 years. As the World Bank (2022a) reports, the number of carbon pricing programs worldwide rose sharply from just 9 in 2005 to 66 in 2022. With this growth, the share of global greenhouse gas emissions covered by such measures also increased—from 5% to 23%. Both carbon taxes and ETSs are commonly used, but ETSs tend to cover a larger share of emissions. Of the 66 existing initiatives, 32 are ETSs, accounting for about 17% of global emissions, while 34 carbon tax systems cover roughly 6% (World Bank, 2022a).

The impact of carbon pricing on "carbon leakage" remains a topic of ongoing debate. Some studies, such as those reviewed by Venmans, Ellis, and Nachtigall (2019), suggest that carbon pricing has little to no effect on the competitiveness of domestic industries and, therefore, does not necessarily lead to carbon leakage. However, the authors also caution that these conclusions might be influenced by exemptions within carbon pricing systems. For instance, under the EU Emissions Trading System (EU ETS), many companies receive free allowances, which may reduce the risk of leakage. Without such protective measures, the risk of companies relocating production to countries with looser climate regulations could be much higher. On the other hand, Misch and Wingender (2021) argue that the findings of minimal leakage could also stem from limitations in data and research methods. Using their own approach and statistical analysis, they demonstrate a clear and statistically significant link between carbon pricing and

carbon leakage, highlighting that the issue may be more serious than previously thought.

Carbon Border Adjustment Mechanisms (CBAM) is increasingly seen as a potential tool to reduce—or even prevent—carbon leakage. These measures work by charging imports based on their carbon footprint, helping to ensure that domestic companies—already subject to carbon pricing—aren't placed at a disadvantage. CBAM can not only reinforce climate objectives but also safeguard national tax revenues by discouraging companies from shifting production to countries with laxer environmental rules.

However, CBAM are still largely conceptual, with no country having fully implemented them. As a result, most of the evidence on their potential effects comes from economic modeling, which depends heavily on the assumptions used. A study by Weitzel, Hübler, and Peterson (2012) explores how the level of a carbon tariff under a CBAM is influenced by two main factors. The first is strategic—where higher tariffs improve trade terms in favor of domestic firms. The second is environmentally aimed at reducing emissions from overseas production. Their findings suggest that when the importing country has significant market power and sets a high tariff, exporters respond by cutting emissions.

Using a multi-regional, multi-sectoral Computable General Equilibrium (CGE) model, the authors found that CBAM can indeed reduce carbon leakage. However, this effect diminishes with higher tariffs, meaning additional increases bring fewer environmental gains. The study also raises concerns that powerful economies might use CBAM more to boost domestic competitiveness than to achieve climate goals, prioritizing trade advantages over genuine emissions reductions.

The potential of CBAM to curb carbon leakage has been examined in numerous studies. For example, Dong and Whalley (2009) applied a two-sector Computable General Equilibrium (CGE) model to evaluate the impact of BCAs in the United States and European Union. Their results showed that CBAM can indeed help

reduce carbon leakage, although the broader effects on trade and economic welfare appear to be relatively limited.

Likewise, Böhringer, Balistreri, and Rutherford (2012) analyzed findings from 12 CGE models applied in various countries. Their study affirmed that CBAM is generally effective in mitigating leakage but also revealed that many countries view these measures not just through an environmental lens, but as a strategy to transfer the financial burden of emissions reduction to nations with less stringent climate policies.

Further studies by Kuik and Hofkes (2010) and Zachmann and McWilliams (2020) echoed these conclusions. They emphasized that CBAM is often used to safeguard the competitiveness of domestic industries, especially those facing strong international competition. This suggests that strategic economic motivations—such as improving trade terms for local firms—frequently underpin the rationale for introducing CBAM.

European policymakers often describe CBAM to create fairer competition between EU companies and foreign producers. It's a big step—the first time such a system has been put into practice anywhere in the world. Naturally, this has raised concern among the EU's trading partners, many of whom wonder whether the CBAM fits within the rules of international trade and the World Trade Organization (WTO).

Because the CBAM is so new, both governments and researchers have tried to get a sense of what it might mean economically. But earlier studies had to work with draft versions of the policy, since the final details weren't yet available. For instance, Kuusi and colleagues (2020) used a gravity model—a tool often used to predict trade flows—to estimate how the CBAM could affect imports into the EU. Their work offered some early insights into how global trade might shift once the mechanism is in place.

Zooming in on a national perspective, Pohjola and Soimakallio (2022) examined how the European Commission's CBAM proposal could affect Finland's imports.

Their gravity model predicted a 25% drop in imports of goods covered by the CBAM from non-EU countries. To add depth to their findings, they also used a Computable General Equilibrium (CGE) model, which showed that EU industries producing these regulated goods would stand to gain the most. Meanwhile, the broader EU economy was expected to feel little to no significant impact.

The researchers didn't stop there—they also tested different versions of the CBAM and found that, depending on the final design, overall EU imports could fall by anywhere from 2.7% to 4.8%. Among the hardest-hit sectors were chemical products and iron and steel, which are likely to see the steepest declines in import volumes under the new rules.

One of the potential advantages of CBAM to developing countries is its capability to promote cleaner production and accelerate the adoption of green technology. Border carbon pricing sends a message to exporters that access to key markets, such as the EU, will depend increasingly on their ability to demonstrate lower emissions intensity. This shift in market preferences can speed up innovation, cause investments in energy savings, and compel firms to implement global environmental best practices.

Early mover nations with the adoption of green manufacturing practices and carbon accounting systems can gain competitiveness in low-carbon value chains. Governments that move early in responding to CBAM by establishing robust emissions MRV systems can increase their export resilience and green investment attractiveness. For example, South Africa and Morocco are already exploring carbon market mechanisms and climate finance strategies in a bid to enhance their CBAM readiness. It not only places them in a better position in the global market but also comes with co-benefits, such as cleaner air, energy security, and jobs in green sectors.

Secondly, CBAM can be a vehicle of regional coordination for carbon pricing and climate policy harmonization. With regions of interdependence of trade with the EU, countries could find common grounds in harmonizing environmental norms

and common resources for joint investments in common infrastructure, i.e., renewable energy networks or green ports. Regional coordination of this type can reduce the transactional cost of aligning with CBAM and promote a fair and efficient green transition.

In economic theories that we learned from universities, such as Ricardo's theory of comparative advantage and the Heckscher-Ohlin model, it is said that countries benefit by specializing in the production of goods for which they have relative efficiency. In the CBAM case, a carbon cost layer may distort these advantages. For example, when a country has a comparative advantage in steel production due to cheap energy and labor but lacks strict environmental regulations, CBAM could render its exports uncompetitive in EU markets. Critics argue that CBAM could be perceived as "eco-protectionism," potentially violating World Trade Organization (WTO) norms if it disproportionately penalizes exporters from the Global South (Krugman, 1994). This raises questions of fairness, legality, and the necessity for complementary trade and environmental policies.

The World Bank's Relative CBAM Exposure Index provides a tool for a first assessment of the exposure of third countries to the EU CBAM, using carbon emissions intensity and exports of CBAM products to the EU.

Information on embedded carbon emissions is sourced from the OECD's Greenhouse Gas Footprint Indicators, which include energy- and process-related emissions for various greenhouse gases across numerous industries and countries. These figures are supplemented by data from the U.S. Environmentally Extended Input-Output. Additionally, data at the installation level from the EU Transaction Log (EUTL) are employed to calculate the extent of EU ETS coverage and free allowance allocations by country and sector.

This analysis shows that the current CBAM regulation applies to a relatively small share of global emissions and international trade. Specifically, CBAM-covered trade amounts to USD 132 billion, representing just 0.37% of global trade in goods and services, and around 3% of trade from non-EU countries to the EU.

Imports into the EU from non-EU countries under CBAM account for 171 million tonnes of CO_2 equivalent, or 0.31% of total global emissions. The majority of CBAM-related trade involves basic metals, mainly imported from China, Türkiye, and Russia. About 24% of the embedded emissions regulated by CBAM are attributed to Scope 2 and 3 emissions. In the European context, CBAM-relevant goods made up 7% of manufactured goods sold in 2019, equating to 2.3% of total gross output, 1.1% of value added, and 0.6% of employment across the EU. With a carbon price of EUR 80 per tonne of CO_2 (as of January 1, 2024), and assuming stable trade flows, the CBAM could generate annual revenues of approximately EUR 14.7 billion (USD 15.3 billion).

Understanding these indirect effects is essential, especially because the CBAM targets upstream sectors, which means it can influence a broad range of firms further along with the production process. To capture how cost changes ripple through the economy, the analysis employs a Leontief price model (also known as a cost-push model), which traces cost transmission while accounting for the potential for input substitution, varying price elasticities, and changes in quantities. This modeling approach is similar to those used by Hebbink et al. (2018) and Schotten et al. (2021), and it is designed to estimate short-term, first-order effects of policy changes.

The model simulates short-run adjustments such as switching inputs, improving efficiency, and altering prices and production volumes. It provides detailed insights into how various policies influence trade patterns, value creation, and carbon emissions. However, the model does not account for longer-term structural adjustments—like changes in production techniques, reallocation of domestic resources, or new climate policies being adopted by non-EU countries in response to CBAM.

The impact analysis compares economic indicators across several policy scenarios. The first scenario models an increase in the EU ETS carbon price due to a tighter emissions cap and the removal of free allowances for sectors not

classified as energy-intensive, trade-exposed (non-EITE), in line with recent EU proposals (European Commission, 2023). Under this scenario, free allowances remain available for EITE sectors, including those affected by CBAM. The second scenario builds on this by also removing free allowances for EITE sectors. Finally, the "Full Policy Mix" scenario incorporates the CBAM itself and most closely reflects the EU's broader 'Fit for 55' climate package.

Getting rid of free emissions allowances and rolling out the CBAM don't affect all EU industries the same way—some feel the hit much harder than others. For example, sectors like Basic Metals and Non-Metallic Minerals, which used to receive free allowances covering over 85% of their emissions, now face steep price hikes and drops in value added of up to 2.8%. The CBAM does help soften the blow for the Basic Metals sector, but it doesn't offer as much protection for Non-Metallic Minerals, mostly because fewer of its products are included in the policy.

These changes don't stop with the directly affected sectors. Industries that rely on materials from CBAM-covered sectors—like Construction and Electrical Equipment—also feel the squeeze. Even though they aren't directly targeted by the policy, they're hit with rising input costs, which slightly reduce their value added. And since these downstream industries make up the majority of the EU economy, they account for a staggering 83% of the overall economic loss in value added. This really drives home the point that policies like CBAM have wider effects along the entire value chain, not just where they're aimed.

When looking at the impact country by country, there's also a lot of variation. It mostly depends on how carbon-intensive a country's production is and whether they already have carbon pricing in place. With CBAM in force, EU companies tend to buy more from cleaner producers who already price their carbon, since that lowers the CBAM fee. As a result, most non-EU countries see small economic gains under the new rules, especially low-emission countries like Chile. On the flip side, countries like South Africa, India, and Tunisia—which have higher

emissions in their production—see slight declines in value added (around -0.25%). Overall, this suggests that CBAM can help reduce carbon leakage by nudging EU importers toward cleaner, more climate-friendly trading partners.

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Since the current CBAM rules mention that the list of covered products might be expanded in the future, the paper also explores what would happen if the CBAM were applied to 1,400 more goods that are both emission-intensive and heavily traded. The analysis shows that even with this broader coverage, the EU would experience only a slight additional loss in value added (just 0.08%), and global emissions would fall by another 0.02%. This suggests that the original product list was chosen wisely—it achieves a strong environmental impact without covering too many goods.

However, the expanded scenario also reveals that many downstream industries not directly covered by CBAM would feel a stronger pinch due to indirect effects across the value chain. Protecting these sectors from carbon leakage would require expanding the CBAM even further, which could be technically difficult and complex to implement.

To ensure the results are reliable, the paper runs a series of sensitivity checks. These tests look at how the outcomes change under different carbon prices, trade responsiveness, and lower rates of passing costs onto consumers. While the size of the effects naturally shifts depending on the assumptions, the overall picture—especially which sectors and countries are most affected—remains consistent.

When countries implement ambitious climate policies at home, there are often concerns about losing economic competitiveness and triggering what's known as *carbon leakage*. This happens when emissions simply shift to other countries with weaker climate rules, rather than being reduced overall (Fowlie & Reguant, 2018). Researchers generally identify two main ways this leakage can happen:

- Direct leakage happens through trade and investment. If stricter climate policies raise production costs, domestic industries might struggle to compete internationally. This can lead to fewer exports and more imports. Over time, companies might also shift manufacturing to countries with laxer environmental standards to cut costs.

- Indirect leakage works through energy prices. When major countries reduce their fossil fuel use due to climate policies, global demand for these fuels can drop—leading to lower prices. As a result, other countries may start using more fossil fuels, which can increase their emissions (Daubanes, Henriet & Schubert, 2021; Keen & Kotsogiannis, 2014).

This offers a brief summary of the carbon leakage debate, including both *ex-ante* (predictive) and *ex-post* (real-world) studies. Interestingly, *ex-ante* models usually forecast higher levels of carbon leakage than what is actually observed in practice. One reason is that these models often assume larger price increases than what ends up happening. They also tend to overlook real-world frictions and delays—factors that can slow down how quickly industries and markets respond to new climate policies.

A growing body of research has explored how effective Carbon Border Adjustment Mechanisms (CBAMs) are in tackling carbon leakage. Major reviews—such as those by Cosbey et al. (2019), Böhringer et al. (2022), Zhong and Pei (2023), and Fontagné and Schubert (2023)—have looked at the design and predicted impact of CBAMs using various modeling approaches, primarily computable general equilibrium (CGE) models.

Overall, the evidence suggests that CBAMs can significantly reduce carbon leakage. Compared to scenarios without any border adjustments—where leakage rates typically range between 5% and 25%—the introduction of a CBAM brings this down to −5% to 15%, with an average around 6%. In some cases, the models even show negative leakage rates, meaning emissions abroad are also reduced. This is attributed to technology diffusion and learning spillovers, as seen in studies like McKibbin et al. (2008) and Mathiesen and Maestad (2004).

CBAMs are also shown to cushion the economic impact of climate policies, particularly by reducing output losses in CGE models. However, partial equilibrium (PE) models, which focus on specific sectors, tend to show smaller benefits in this regard (Branger & Quirion, 2014).

Interestingly, the research finds that climate policies tend to affect exports of emissions-intensive and trade-exposed (EITE) goods more than overall production, highlighting the vulnerability of trade flows.

That said, both CGE and PE models share a common limitation: they typically don't capture differences between firms—especially when it comes to pollution intensity. This matters because, as shown by Holladay (2016), climate policies and increased import competition can drive out the smallest and most polluting firms, ultimately lowering the average emissions of producers in the affected market.

CBAM Transitional Phase (2023–2025) and implementation

On October 1, 2023, the Carbon Border Adjustment Mechanism (CBAM) came into effect in its transitional phase. The first reporting deadline for importers was January 31, 2024. This gradual rollout is intended to provide a smooth, predictable, and balanced transition for businesses both inside and outside the EU, as well as for relevant authorities.

Initially, CBAM covers imports of specific carbon-intensive goods that are most vulnerable to carbon leakage. These include cement, iron and steel, aluminum, fertilizers, electricity, and hydrogen. With this broad scope, CBAM is expected to eventually cover over 50% of emissions from sectors included in the EU Emissions Trading System (ETS). The transitional period serves as a trial phase for all parties—importers, producers, and regulators—to gain experience and collect data on embedded emissions, helping to refine the methodology for the system's full implementation.

During this phase, importers are only required to report greenhouse gas (GHG) emissions associated with their imported goods, both direct and indirect, without the obligation to purchase or surrender CBAM certificates. For certain sectors like cement and fertilizers, indirect emissions will be included after the transitional

phase, based on the methodology detailed in the Implementing Regulation released on August 17, 2023.

The regulation also allows flexibility in how emissions are reported during the transition. Until the end of 2024, companies can choose from three reporting options: (a) full reporting using the EU methodology; (b) reporting using an equivalent approach (three alternatives are offered); or (c) reporting based on default reference values (available only until July 2024).

Beginning January 1, 2025, a new section of the CBAM Registry will allow non-EU installation operators to upload and share emissions and installation data directly with CBAM declarants, streamlining the process and eliminating the need to submit data to each declarant individually.

Also from early 2025, companies will be able to apply for the status of "authorised CBAM declarant" through the CBAM Registry. Applications will be reviewed by the competent authority in the EU Member State where the company is based. From January 1, 2026, this status will be mandatory for all importers of CBAM goods into the EU.

The European Commission plans to open the application process for this status once the relevant Implementing Act is adopted (expected in March). Comprehensive guidance materials will be released alongside this process.

Electricity generated within the Exclusive Economic Zone (EEZ) of EU Member States and imported into the EU is considered of "EU origin" and is therefore exempt from CBAM requirements, including both reporting obligations during the transition and carbon cost adjustments post-2026 (see FAQ, Question 95). Importers of such electricity do not need to register as authorised CBAM declarants or access the CBAM Registry.

A full review of CBAM’s implementation during the transitional phase will be completed before the start of the definitive system. At that time, the EU will also assess whether additional products, such as downstream goods from ETS-covered

sectors, should be included under CBAM. The findings will include a timeline for potential inclusion by 2030.

The effect of CBAM on Russia

Experts have been trying to pin down exactly what CBAM might mean for Russia's economy—and the numbers vary depending on how the future plays out. Early forecasts raised some alarms. For example, McKinsey & Company estimated that if Russia doesn't take steps to lower the carbon intensity of its exports, it could be paying around €1.7 billion per year by 2030, and as much as €6 billion annually by 2050 just in CBAM-related costs.

Another estimate from the Institute for Natural Monopolies Research (IPEM) predicted that the annual financial burden for Russian exporters could land somewhere between $700 million and $1.8 billion, possibly climbing to $2.2 billion once indirect costs—like compliance and adjustments across supply chains—are included.

But newer, more detailed studies paint a less dramatic picture. A model developed by the Center for Energy Efficiency XXI (CENEF-XXI) suggests that in a scenario where Russia doesn't take action to cut emissions, the financial hit would likely start at around $200 million in 2026 and gradually rise to about $1 to $2 billion by 2050.

The wide range of estimates tells us something important: Russia's future CBAM costs will largely depend on how it responds. Taking real steps toward reducing emissions and improving energy efficiency could not only reduce the financial burden but also position the country more competitively in a world that's moving quickly toward low-carbon trade.

CBAM doesn't affect all parts of the Russian economy equally. The industries feeling the most pressure are those that both emit large amounts of greenhouse gases and rely heavily on exports to the EU. At the top of this list is ferrous metallurgy—including steel and aluminum—which makes up the bulk of Russia's

CBAM-covered exports. These sectors are not only carbon-intensive but also deeply tied to EU demand for revenue.

Other vulnerable sectors include cement, fertilizers, and ammonia, all of which are energy-intensive and export a sizable share of their output to Europe. In 2019 alone, the value of Russian exports subject to CBAM was about $6.7 billion, but if you widen the lens to include goods that might eventually fall under the CBAM umbrella, the figure could reach as high as $52–57 billion a year (World Bank, 2021). That scale reveals just how central EU-bound carbon-intensive exports are to Russia's trade profile—and how big the stakes are.

One of the main factors that will determine how hard CBAM hits Russian exporters is carbon intensity—essentially, how much CO_2 is embedded in a product compared to EU standards. The more carbon a product contains, the higher the CBAM charge. Under EU rules, emissions are measured based on:

- Scope 1: Direct emissions from production,
- Scope 2: Indirect emissions from energy use,
- (Scope 3 is not counted for now): This includes emissions from the wider supply chain.

Here's the problem: many Russian firms don't yet have transparent, verifiable emissions data. Even in cases where a company uses cleaner energy—like aluminum smelters powered by hydropower—they may still be penalized if they can't prove their lower emissions. In such cases, the EU assigns default values, which are generally less favorable and increase the cost.

To manage these risks—and maybe even turn them into opportunities—Russia needs to act on several fronts:

1. Introduce a national carbon pricing system

If Russian companies already pay for carbon emissions at home, the EU allows those costs to be deducted from CBAM payments. That could keep more money inside Russia and fund green investments domestically.

2. Build a solid emissions reporting system (MRV)

A credible measurement, reporting, and verification (MRV) framework would let companies report actual emissions and avoid default penalties. Industry-specific benchmarks would also help make reporting more accurate and fairer.

3. Engage in international negotiations

Russia should push for recognition of its climate efforts and emissions-reducing technologies in CBAM talks. That includes advocating for a fair accounting of its hydropower, energy efficiency, and cleaner production initiatives.

4. Diversify trade partnerships

Overdependence on the EU market is a structural risk. Expanding exports to emerging markets and countries with less stringent carbon pricing could help buffer the impact and build long-term resilience.

The message from the CBAM-RUS model is simple: act now, benefit later. If Russia starts reducing emissions in industries like aluminum and steel today, it can save a lot on CBAM-related costs down the line. But this isn't just about avoiding fees—it's about getting ahead. As the world shifts toward greener trade, countries offering cleaner, low-carbon products will have the upper hand.

There are already some promising tools on the table:

- Cleaner aluminum smelting using inert anodes
- Carbon capture in cement production
- Hydrogen-based methods for making steel

But turning these ideas into reality takes more than good intentions. It means serious investment, clear policies, and working together across industries. The Russian government can help by partnering with business leaders to create sector-by-sector decarbonization plans—and backing them with things like tax breaks, funding, and public-private partnerships.

Other big players—China, India, Turkey—are also adjusting to the rules of this new carbon-focused economy. Those that already use greener energy or more efficient technologies could get ahead faster. That puts Russia in a kind of global race—where speed, innovation, and smart decisions will shape who wins.

Yes, the EU might face some legal and diplomatic pushback as CBAM rolls out. Disputes at the WTO are possible. But the direction of global trade is clear: carbon accountability is here to stay. Instead of fighting it, Russia has more to gain by staying at the table—pushing for fair rules, transparency, and recognition of its own climate efforts.

There's no question—CBAM is a big deal for Russia's current export model. But it's also a chance to modernize, innovate, and lead. It's a chance to rebuild industries for a cleaner future and show that Russian businesses can compete on a global low-carbon stage.

With the right steps—introducing carbon pricing, improving emissions tracking, investing in green technologies, and staying engaged globally—Russia can turn this challenge into a launchpad for long-term success.

Because this isn't just about avoiding costs. It's about staying relevant—and thriving—in the future of global trade.

Impacts of the CBAM on Kazakhstan

The European Union is taking a bold step to make global trade more climate-conscious through its Carbon Border Adjustment Mechanism (CBAM). Rather than ignoring the environmental impact of goods produced elsewhere, the EU plans to hold imported products to the same carbon standards as those made within Europe. Simply put, if a product causes a lot of pollution during its production, that environmental cost will now be reflected in its price at the EU's border. This move encourages cleaner manufacturing practices worldwide. CBAM is closely tied to the EU Emissions Trading System (EU ETS) and will be rolled out fully by 2026. At the outset, it will focus on five major polluting sectors: iron and steel, aluminum, cement, fertilizers, and electricity. Importers will need to buy special CBAM certificates that reflect the emissions linked to their goods—unless the exporting country already uses its own carbon pricing system, in which case the price is adjusted accordingly.

For Kazakhstan, this new policy isn't just theoretical—it hits close to home. Almost half of the country's exports go to the EU, and most of that is crude oil. Although oil isn't currently included under CBAM, that status might not last long. If the EU expands CBAM to cover other carbon-heavy products like petroleum, chemicals, glass, and various metals, Kazakhstan could see a steep rise in the share of its exports affected—from less than 0.5% today to over 3%.

And the ripple effects don't stop at Europe's borders. Kazakhstan also exports a significant amount—about 23% of total exports—in emissions-intensive goods to countries outside the EU. Many of these countries are also weighing similar carbon pricing mechanisms. So the pressure Kazakhstan feels from CBAM now could soon become a global trend.

Among the sectors currently under CBAM, aluminum stands out as the most vulnerable for Kazakhstan. The industry generates nearly USD 200 million annually, with around 30% of that heading to the EU. However, the environmental cost is high. Kazakhstan's aluminum production emits 615 tons of CO_2 for every million dollars of output—much higher than the EU's average of 122, or even China's 489. By comparison, other sectors like fertilizers, cement, electricity, and minerals currently make up a much smaller slice of Kazakhstan's exports and face lower risk.

If the European Union decides to expand CBAM to cover petroleum and chemical products, Kazakhstan could see up to another USD 1 billion in exports come under pressure. That would mark a major shift, pushing the country to rethink its approach in order to stay competitive on the global stage.

The instrument represents more than just a new rulebook—it marks a turning point in the way global trade is adapting to the realities of climate change. For Kazakhstan, it's a strong signal that the world is moving in a new direction. While the shift may pose real challenges, it also opens the door to meaningful change. By embracing low-carbon technologies and modernizing its industries,

Kazakhstan can do more than just meet international expectations—it can shape its own path toward a greener, more competitive, and future-ready economy.

To evaluate CBAM's economic impact on Kazakhstan, the World Bank conducted macroeconomic modeling using the ENVISAGE CGE model and GTAP-10 database. The analysis included the following scenarios:

1. Baseline (No CBAM): Reflects business-as-usual conditions.
2. Current Proposal: Applies CBAM to the five core sectors.
3. Expanded CBAM: Adds all non-ferrous metals, petroleum, coal, chemicals, and glass.
4. US Joins: Applies the expanded CBAM to imports from the United States.
5. All ETS: Includes all products under emissions trading systems in both the EU and U.S.
6. NDC Alignment: Kazakhstan implements its Nationally Determined Contributions (NDCs), reducing emissions intensity and lowering CBAM costs.

The model suggests CBAM would function like a product-specific tariff based on emissions intensity. Products with high emissions or lacking robust monitoring, reporting, and verification (MRV) systems would face higher costs. Countries with credible MRV and domestic carbon pricing mechanisms could partially offset these costs and retain revenues locally.

The potential financial impact of CBAM is considerable. Under the expanded scenario, Kazakhstan’s exports to the EU could decline by nearly USD 1.8 billion. For ferrous metals, exports could fall by 38% under the current proposal and 65% under the expanded one—equating to a USD 650 million loss. Aluminum exports could drop 4% (USD 60 million) under the current scenario and 16% (USD 250 million) under the expanded scenario. Petroleum and chemicals could suffer reductions of approximately 30% in export value if included.

Although some trade could be diverted to non-EU markets, this is not guaranteed due to logistical and market limitations. Diversion potential is greater for

aluminum and chemicals but more limited for petroleum. Even accounting for diversion, net export losses could still total USD 1.4 billion.

CBAM may also offer new opportunities for Kazakhstan's downstream sectors, such as machinery and fabricated metal products. These sectors are not covered by CBAM and could become more competitive in EU and global markets. Under the expanded CBAM, exports of machinery and equipment to the EU could increase by 4%, partially offsetting losses in primary sectors.

CBAM's ripple effects are expected to reduce production in several sectors. Output in ferrous metals could decline by over 2.5%, and aluminum by 0.45%, under the expanded scenario. Petroleum, coal, and chemicals may also experience notable output reductions. Conversely, the machinery and metal products sectors could see output gains.

Employment effects mirror these output trends. Under the expanded CBAM, up to 1,700 jobs could be lost in ferrous metals, 500 in aluminum, and 200 in petroleum. However, modest gains in machinery, oil extraction, and metal manufacturing could offset these losses, especially if Kazakhstan facilitates a structural economic transition.

Despite considerable sectoral impacts, the macroeconomic effect of CBAM on Kazakhstan is projected to be minimal. GDP deviation in 2035 across all scenarios is less than USD 35 million. Household consumption and wages also show marginal reductions. These muted effects rely on the assumption of a smooth reallocation of labor and capital from declining to expanding sectors—an implementation challenge requiring sound policy and planning.

Kazakhstan's alignment with its NDCs can significantly reduce CBAM-related costs. Lower emissions intensity, achieved through clean technologies and carbon pricing, would lead to reduced CBAM payments. For instance, ferrous metal exports to the EU could decline by only 30% instead of 65%, and aluminum by less than 4% instead of 16%. Petroleum and chemicals would also benefit from fewer CBAM penalties.

Sectoral output losses would similarly shrink. With NDC alignment, losses could fall from USD 1.8 billion to approximately USD 500 million. Macroeconomic stability would be preserved, and environmental outcomes improved. Kazakhstan could avoid over 100 million tCO_2e annually in the 2030s—compared to only a 0.5% reduction under a "No Action" scenario.

While the model provides robust projections at the macro and sectoral levels, it does not capture intra-sectoral heterogeneity. Firms employing cleaner technologies could perform better even within declining sectors. Actual CBAM costs will depend on Kazakhstan's MRV capacity, the pace of its carbon pricing reforms, and EU sector-specific rules.

The analysis incorporates assumptions from Shared Socioeconomic Pathways (SSP2) and IMF GDP forecasts, considering post-COVID recovery trends. Additionally, the phaseout of EU free allowances by 2035 may increase CBAM costs unless mitigated by domestic policies.

Initial IMRS Analysis of the CBAM's Impact on Uzbekistan's Exporters

In light of this shifting policy landscape, the Institute for Forecasting and Macroeconomic Research (IMRS) in Uzbekistan carried out a detailed study to assess how the CBAM could affect the country's exporters—especially those operating in energy- and carbon-intensive sectors.

IPMI identified three CBAM policy scenarios under discussion within the EU:

1. Border Carbon Tax — Differentiated by sector and based on the carbon intensity of imported products.
2. Inclusion of Importers in the EU Emissions Trading System (ETS) — Requiring importers to purchase carbon allowances, similar to EU producers.
3. Carbon Value-Added Tax (VAT) — A uniform tax imposed on all carbon-intensive products, irrespective of origin.

IPMI notes that the second and third scenarios would not directly cap emissions and could distort competition by imposing higher compliance costs on EU

producers relative to foreign competitors. Consequently, the EU favors the first scenario—a targeted border carbon tax—as the most effective and equitable mechanism for achieving climate goals while maintaining fair competition (European Commission, 2021).

According to IPMI's analysis, Uzbekistan's industrial production remains significantly more carbon-intensive than that of the EU due to outdated technologies and high energy consumption. The study, based on 2020 trade data, analyzed export flows from Uzbekistan to the EU by commodity code (HS10) and calculated CO_2 emissions per unit of product at the national level.

The findings indicate that this carbon intensity gap places Uzbek exporters at a considerable disadvantage. The additional cost burden imposed by CBAM could exceed $10 million annually, resulting in an estimated 5–6% average increase in the prices of affected Uzbek exports. This price hike would likely erode the competitiveness of these goods in EU markets.

Furthermore, IPMI extended its analysis to include indirect (Scope 2) emissions along the supply chain. When these emissions are considered, the total cost impact of CBAM on Uzbek exports could rise even further, exacerbating economic vulnerability.

The IMRS evaluated potential direct and indirect impacts of CBAM on Uzbekistan's exporters, especially those producing carbon-intensive goods.

Key findings:

- Uzbek goods are more carbon-intensive than EU standards due to older technologies, making them more vulnerable under CBAM.
- Calculations were based on customs data from 2020 using 10-digit trade codes.
- A benchmark CO_2 price of $60 per ton was used in the estimates.
- Additional payments due to CBAM could exceed $10 million annually, increasing average export costs by 5–6%.

The analysis also considered scope 2 emissions (indirect emissions from electricity use), which may increase costs even more along the supply chain.

Risks for Uzbekistan

- Loss of export competitiveness in the EU market
- Decline in export volumes of raw materials and energy-intensive goods
- Higher import costs if similar carbon policies spread globally
- Exposure to stricter decarbonization efforts in the EU, China, India, and OECD countries

To reduce risks and enhance competitiveness, Uzbekistan should:

1. Strengthen national climate policy—promote sustainable business practices and integrate climate governance into corporate structures.
2. Support domestic climate leaders—encourage internal carbon pricing and international climate engagement.
3. Develop a national carbon inventory—track product-level carbon intensity using corporate reporting and scientific data.
4. Invest in R&D and human capital—support innovation and train a green workforce.
5. Diversify the economy—develop low-carbon sectors like renewable energy and electric transport.

Insufficient Empirical Studies on CBAM's Economic and Environmental Impacts in CA

While many macroeconomic models have assessed the global trade implications of CBAM, empirical research focused on Central Asian economies—especially Uzbekistan and Kazakhstan—remains limited and underdeveloped. Most available studies extrapolate generalized findings without reflecting the region's specific socio-economic and institutional context. For example, Central Asian countries are characterized by a heavy reliance on carbon-intensive sectors such

as metallurgy, cement production, and fossil fuel extraction—industries that are directly targeted under CBAM. Furthermore, outdated industrial infrastructure, weak environmental regulations, and high energy subsidies exacerbate emissions intensity and limit the feasibility of rapid decarbonization.

In the case of Uzbekistan, the economy has historically depended on natural gas exports, while Kazakhstan remains one of the most carbon-intensive economies per unit of GDP among the OECD's key partners. These structural features are rarely examined through detailed empirical research that would help quantify the economic vulnerability of specific sectors or firms under CBAM. Likewise, the lack of disaggregated, firm-level emissions data, as well as national lifecycle emissions metrics, impedes the development of realistic transition pathways. The absence of longitudinal studies also prevents analysis of how CBAM will impact these economies over time, including shifts in comparative advantage, trade patterns, and employment.

Moreover, there is minimal incorporation of feedback loops between environmental performance and trade competitiveness. Empirical work is needed to assess how shifts in EU regulatory thresholds, such as the phasing out of free allowances or changes in the carbon price under the EU Emissions Trading System (ETS), might amplify economic distortions in countries with fragile fiscal systems. Without this evidence base, policymaking remains reactive and fragmented, and regional actors risk being sidelined in the broader global transition to sustainable trade norms.

In Uzbekistan and Kazakhstan, nascent capital markets, limited institutional knowledge, and a lack of policy incentives inhibit the development of ESG ecosystems. Despite government interest in sustainable finance, mechanisms such as green bonds, ESG-linked credit lines, and blended finance instruments remain underutilized. Integrating ESG into CBAM adaptation strategies would require developing clear taxonomies for green activities, adopting disclosure frameworks, and fostering capacity-building initiatives in both public and private sectors.

Additionally, national development banks and sovereign wealth funds could be leveraged to co-finance low-carbon technology adoption in industries most exposed to CBAM.

Literature Review Comparison: CBAM Impact on Kazakhstan and Uzbekistan

Dimension	Kazakhstan	Uzbekistan
Trade Exposure	~45% of exports go to the EU; primarily crude oil (currently excluded, but may be added later).	Smaller export volume to the EU; mainly ferrous/non-ferrous metals, fertilizers, and chemicals.
Sectors Initially Affected	Aluminum (high exposure), ferrous metals, fertilizers, cement, electricity.	Ferrous and non-ferrous metals, chemicals, cement, fertilizers, petroleum.
Carbon Intensity	Very high – e.g., aluminum production emits 615 tCO_2e/million USD vs. EU's 122.	Also high, due to outdated technology and energy use.
Projected Export Losses	Up to $1.8 billion in expanded CBAM scenario; aluminum: -16%, ferrous metals: -65%.	Estimated $10+ million annually in direct CBAM costs, with 5–6% price increases in affected exports.
Sectoral Impacts	Major losses in metals, petroleum, and chemicals; some offset by gains in machinery/fabricated goods exports.	Risks to key sectors: metallurgy, chemicals, and energy; loss of competitiveness and market share.
Employment Effects	Up to 2,400 jobs lost in exposed sectors; possible gains in machinery/oil extraction.	Not quantified, but likely negative in energy-intensive sectors without immediate diversification.
Macroeconomic Impact	Relatively small GDP impact (~$35 million in 2035), assuming smooth sectoral reallocation.	Not detailed, but significant structural vulnerability noted; less diversified economy increases systemic risk.
Policy Recommendations	Invest in MRV systems, carbon pricing, green infrastructure, and workforce transition.	Strengthen climate governance, develop carbon inventory, foster low-carbon tech/R&D, and diversify exports.
Opportunities	Downstream sectors (e.g., machinery) could become more competitive in EU markets.	Transition to renewable energy, green technologies, and sustainable exports.
Climate Policy Alignment	Meeting NDC targets could reduce export losses by up to 70% and avoid 100 Mt CO_2 annually.	Aligning with international climate goals needed to maintain long-term competitiveness.
Modelling Approach	Computable General Equilibrium (CGE) model (ENVISAGE + GTAP-10) by World Bank.	Scenario analysis using 2020 trade data and national-level carbon intensity by IPMI.
Implementation Risks	Delay in carbon pricing or MRV reform increases vulnerability.	Lacks robust MRV and ETS systems; needs capacity building and investment to avoid disproportionate impact.

Research Gaps Identified

Since CBAM reporting is set to begin in 2025 and payments are expected to start in 2026, this is considered a new topic for us. Until now, most research has been conducted by international organizations or scientific research institutes within the European Union. I consider this a natural situation. We can also anticipate that many changes will occur in this area.

From my review of research on the topic, I've found that the subject of CBAM has not been comprehensively studied in the context of Uzbekistan. The Ministry of Economy and Finance, which is responsible for this area, is currently conducting several initiatives with the support of international organizations. I have also made use of their findings in my own work.

Given the evolving economic processes, economic research demands that CBAM be examined as a distinct policy instrument. There is a limited body of scientific research on how the existing CBAM framework may affect Uzbekistan's national economy and its environmental impact.

Therefore, I can say that my work serves as a contribution to the ongoing research efforts in this field.

SECTION 3. METHODOLOGY

Research Design

In the course of this research, the formulas introduced by the European Union for calculating CO_2 emissions are presented. To calculate CBAM-related costs, the amount of CO_2 calculated by the enterprise is multiplied by the proportion corresponding to exports. This is done through a simple arithmetic calculation, which helps determine the level of economic impact.

To assess the environmental impact, the effect of measures against CBAM that can be implemented by enterprises and the government is evaluated. In addition,

interviews with enterprise representatives and relevant government officials also help determine the quality and reliability of the assessment.

In assessing the macroeconomic impact, the total export volume is analyzed along with the share of the European Union within it, as well as the volume of products subject to CBAM. This provides a basis for decision-making at the national level. In the process of microeconomic analysis, the ratio of each enterprise's total production volume to its exports to the European Union is examined. The results of the micro-level analysis highlight the importance of enterprise-level modernization, the installation of energy-efficient equipment, and the adoption of green production principles.

The mixed-methods approach is suitable for integrating numerical data and contextual understanding, enabling triangulation and strengthening the validity of findings (Creswell & Plano Clark, 2018).

Data Collection Methods

Primary Data*:*

- Statistical data from Uzkimyosanoat JSC
- Interviews with experts of Uzkimyosanoat, Navoiyazot JSC, GIZ, Ministry of Economy and Finance.

Secondary Data*:*

- State Committee of the Republic of Uzbekistan on Statistics
- Ministry of Economy and Finance of Uzbekistan
- Trade statistics, emissions data
- EU CBAM documentation
- Reports from international organizations and consulting companies (ADB, World Bank, GIZ, KPMG…)

Methods for calculating embedded emissions as per Regulation (EU) 2023/956

Officially, importers in the EU will be required to submit emissions declarations and purchase CBAM certificates. However, CBAM-covered goods are relatively standardized, which means there will be limited room to raise prices for consumers. As a result, importers are likely to pass on CBAM-related costs partially—or even entirely—to their suppliers.

Additionally, importers must report the actual emissions associated with imported goods, and they will request this information from their suppliers. The European Commission has published a supporting template that contains all the information importers need to complete the emissions declaration.

While the template is not mandatory, it is highly likely that importers will insist that their suppliers complete it.

Exporters are required to submit information separately for each production facility (if more than one exists) and for each CBAM product group sold to an EU importer:

1. General file/entry information – *not filled out by the exporter*
2. Company information, products/production processes, energy use, and greenhouse gas (GHG) emissions – *must be completed by the exporter*
3. Summary data – *calculated automatically, though some fields require input from the exporter*

To support both potential use by verifiers and to ensure transparency and consistency in internal processes, it is strongly recommended to develop methodological documentation that includes:

- A description of production processes and system boundaries (ideally with a diagram)
- An explanation of emission calculation methods used for each emission source
- The approach to data collection and processing
- Sampling methods for materials and fuels (if applicable)

- The other documentation: laboratory analyses, instrument calibration, calculation methods, standard values with sources, control procedures, and secure data archiving.
- Regular reviews to identify opportunities to improve the monitoring system

When selecting and documenting a monitoring methodology, it is important to focus on the following goals:

- The methodology should be as straightforward as possible, adapted to existing systems at the production site.
- It should be transparent and clear how the data is generated and compiled, particularly for verification purposes during the definitive phase of CBAM. This includes documenting all calculations and assumptions made, as well as control measures used to ensure data accuracy.
- Supplementary documentation should include detailed instructions for all activities covered by the methodology. These should clearly define staff roles and responsibilities and indicate where relevant data is stored.

Calculation-based approach: Emissions are determined for each source based on activity data (e.g., fuel consumption) and, if needed, additional parameters obtained through laboratory analyses or standard values.

The alternative methods can be considered valid if they are part of an established carbon pricing system, a legally required emissions monitoring program, or a verified monitoring framework implemented at the production level—such as those used in greenhouse gas reduction initiatives. To qualify, these methods must provide data that is comparable in scope and accuracy to EU standards. Examples include Predictive Emissions Monitoring Systems (PEMS).

Formula for calculating the specific actual embedded emissions:

$$SEEg = AttrEmg / ALg$$

Source: Regulation (EU) 2023/956

SEEg are the specific embedded emissions of goods g, in terms of CO2e per tonne;

AttrEmg are the attributed emissions of goods g, and

ALg is the activity level of the goods, being the quantity of the goods produced in the reporting period in that installation.

The attributed emissions shall be calculated using the following equation:

$$AttrEmg = DirEm + IndirEm$$

Source: Regulation (EU) 2023/956

DirEm are the direct emissions, resulting from the production process, expressed in tonnes of CO2e, within the system boundaries referred to in the implementing act, and

IndirEm are the indirect emissions resulting from the production of electricity consumed in the production processes of goods, expressed in tonnes of CO2e, within the system boundaries referred to in the implementing act .

For calculating the specific actual embedded emissions of complex goods produced:

$$SEEg = (AttrEmg + EEInpMat) / ALg$$

Source: Regulation (EU) 2023/956

AttrEmg are the attributed emissions of goods g;

EEInpMat are the embedded emissions of the input materials (precursors) consumed in the production process. Only input materials (precursors) listed as

relevant to the system boundaries of the production process as specified in the implementing act adopted.

ALg is the activity level of the goods, being the quantity of goods produced in the reporting period in that installation,

The relevant EEInpMat are calculated as follows:

$$\boldsymbol{EEImpMat = \sum_{i=1}^{n} Mi * SEEi \sum n}$$

Source: Regulation (EU) 2023/956

Where:

Mi represents the mass of input material (precursor) i utilized in the production process, while **SEEi** refers to the specific embedded emissions associated with that input material. For **SEEi**, the operator must apply the emissions value originating from the facility where the input material was manufactured, provided that reliable measurement data from that facility is available

Default values must be established using the most reliable and publicly accessible data available. These values will be regularly updated through implementing acts, reflecting the latest trustworthy information, including data submitted by third countries or groups of countries. When an authorised CBAM declarant is unable to accurately determine actual emissions, default values will apply. These defaults correspond to the average emission intensity of the exporting country for each product listed in Annex I of the Regulation, excluding electricity, with an added mark-up. If reliable data from the exporting country is unavailable for a specific product, default values will be based on the average emission intensity of the X%

worst-performing EU ETS installations for that product. The specific X% will be defined in implementing acts to uphold CBAM's environmental integrity, using the most current and credible data, including insights gathered during the transitional period.

List of goods and greenhouse gases

For the purpose of the identification of goods, this Regulation shall apply to goods falling under the Combined Nomenclature ('CN') codes set out in the following table. The CN codes shall be those under Regulation (EEC) No 2658/87.

Fertilisers

CN code	Greenhouse gas
2808, 2814, 2834 21 00 – Nitrates of potassium	Carbon dioxide and nitrous oxide
3102 – Mineral or chemical fertilisers, nitrogenous	Carbon dioxide and nitrous oxide
3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium	Carbon dioxide and nitrous oxide

Source: Regulation (EU) 2023/956

Aluminium

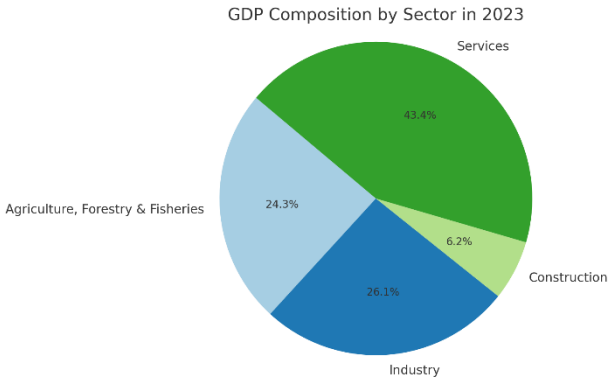
CN code	Greenhouse gas
7601 – Unwrought aluminium	Carbon dioxide and perfluorocarbons
7603 – Aluminium powders and flakes	Carbon dioxide and perfluorocarbons
7604 – Aluminium bars, rods and profiles	Carbon dioxide and perfluorocarbons
7605 – Aluminium wire	Carbon dioxide and perfluorocarbons
7606 – Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	Carbon dioxide and perfluorocarbons
Other articles of aluminium 7607, 7608, 7609, 7610, 7611, 7612, 7613, 7614, 7616	Carbon dioxide and perfluorocarbons

Source: Regulation (EU) 2023/956

SECTION 4. MACROECONOMIC & MICROECONOMIC ANALYSIS AND ENVIRONMENTAL IMPACT

Macroeconomic Analysis

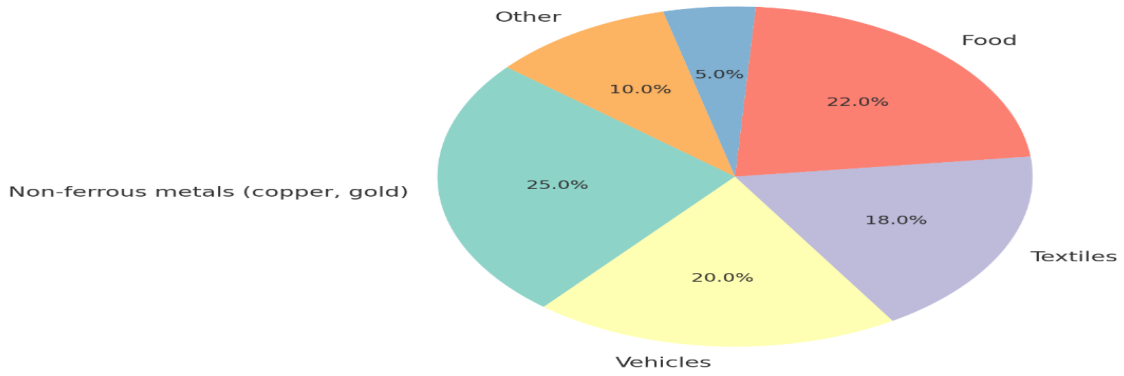
In terms of GDP structure for 2023, agriculture, forestry, and fisheries made up 24.3 percent, industry 26.1 percent, construction 6.2 percent, and the services sector 43.4 percent. The growth in GDP was driven primarily by services (2.6 percentage points), followed by industry (1.5 percentage points), agriculture, forestry, and fisheries (1 percentage point), and construction (0.4 percentage points)



Sectoral Contributions to GDP Growth (2023)	Contribution (%)
Services	2.6
Industry	1.5
Agriculture, Forestry & Fisheries	1.0
Construction	0.4

Source: stat.uz

Preliminary data for 2023 show that over 69.4 thousand industrial enterprises produced goods worth 655.8 trillion UZS, representing a 6% increase in volume compared to the same period of the previous year. The processing industry accounted for the highest share at 84.4 percent.



Source: tradingeconomics.com

Main Manufacturing Outputs

The pie chart highlights Uzbekistan's key industrial products. The dominant outputs are:

- Non-ferrous metals (copper, gold): 25%
- Food products: 22%
- Vehicles: 20%
- Textiles: 18%
- Fertilizers & Iron/Steel: 5%

Manufacturing is one of the fastest-growing sectors in Uzbekistan. From 2014 to 2020, industry's share of GDP grew from 14% to 20%, stabilizing at 20–21% through 2023. However, compared internationally, the share remains slightly below average.

The main manufacturing outputs: non-ferrous metals (copper, gold), vehicles, textiles, food.

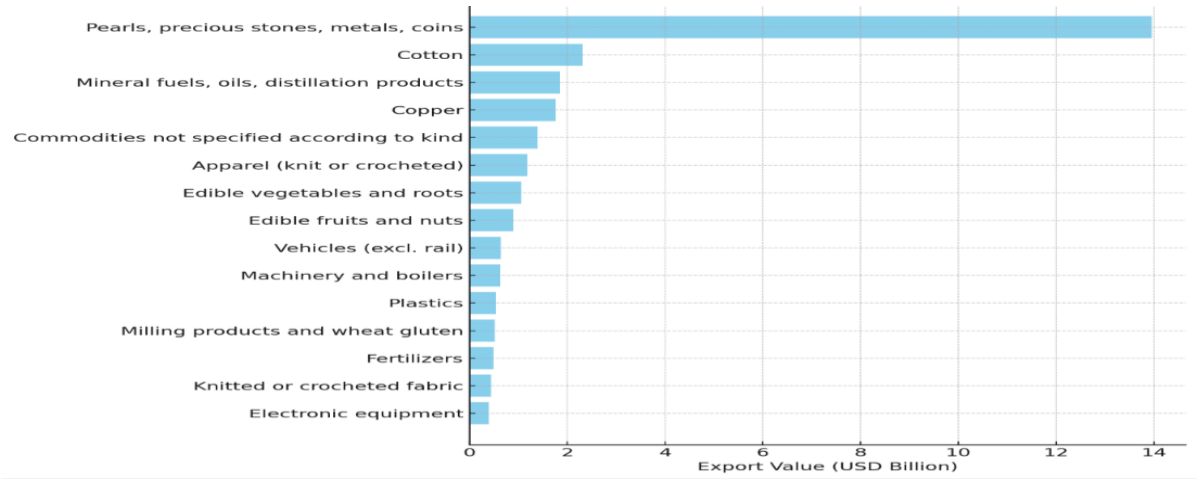
Uzbekistan exported in the amount of US$31.86 billion last year, according to data from the United Nations COMTRADE database. Our main trading partners were Russia, China, and neighboring countries such as Kazakhstan, highlighting the country's strong economic ties within the region and with major global players.

Based on this, it has been identified that Uzbekistan's most CBAM-sensitive economic sector is the chemical industry. Greenhouse Gas Emissions from Chemical Industry Enterprises under the CBAM Mechanism.

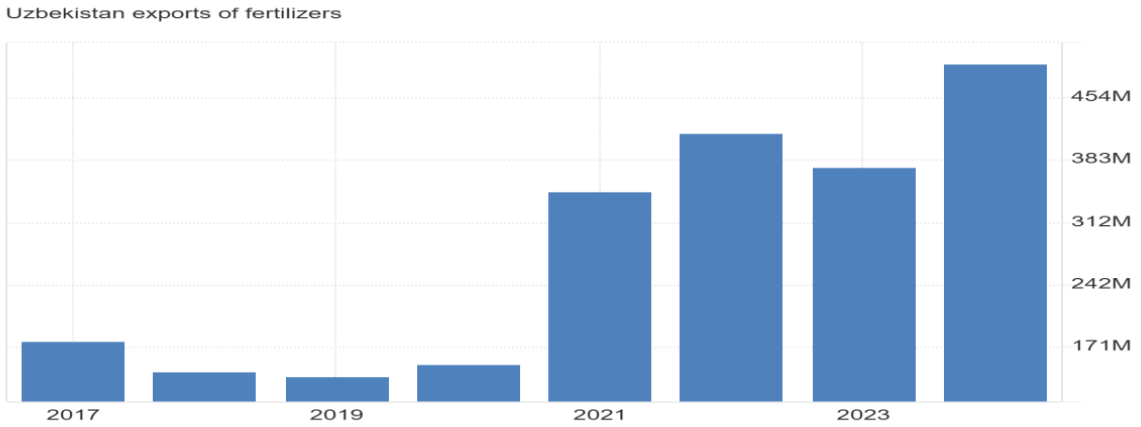
According to the analysis results, the volume of goods exported to the European Union fell under the scope of the CBAM mechanism amounted to **101.967 million USD** in 2024.

Source: Green Economy Projects Center

Top 15 export categories of Uzbekistan in 2024



Source: tradingeconomics.com



Source: tradingeconomics.com

According to the data provided by the Ministry of Economy and Finance of Uzbekistan, the total value of goods exported to the European Union that fall under the scope of the CBAM mechanism amounted to **101.967 million USD** in 2024. Of this:

- 94% was Fertilizers
- 4% was Iron and Steel
- 2% was Aluminum
- 0% Cement, Electricity and Hydrogen

The share of CBAM products in export value is calculated as: (CBAM products value / Total exports) × 100% = (US$101.967 million / US$31.86 billion) × 100% = 0.32%

As seen from the above calculation, CBAM-covered goods account for **0.32% of total exports**.

Now, let's calculate the CBAM cost based on this value. Considering that companies have not yet submitted CBAM reports, we will use the default value in accordance with the CBAM regulation.

Fertilizers

Based on the above, the *Green Economy Projects Center* (hereinafter referred to as the Center) and *Uzkimyosanoat JSC* (hereinafter referred to as the Company) jointly carried out research on the status of chemical industry enterprises.

According to the export data provided by the Company, in 2024, Uzbekistan's exports to the European Union consisted solely of products classified under HS codes 3102 (Mineral or chemical fertilizers, nitrogenous) and 3105 (Mineral or chemical fertilizers containing two or three of the fertilizing elements nitrogen, phosphorus, and potassium; other fertilizers).

In accordance with Clause 9, Appendix 4 of the Presidential Decree of the Republic of Uzbekistan No. PF-16 dated January 30, 2025, it is mandated to conduct an inventory of greenhouse gas emissions from chemical industry enterprises and to assess the impact of carbon regulation mechanisms.

To ensure the implementation of this directive, the following measures have been approved:

1. Conduct a pilot inventory of greenhouse gas emissions at two domestic chemical industry enterprises that produce chemical products.
2. Based on the results of the inventory, develop proposals to improve readiness for compliance with international standards and submit them to the Cabinet of Ministers.

EU CBAM default emission values for fertilizers, applicable during the transitional period (1 October 2023 – 31 December 2025):

- For most fertilizer products (aggregated CN code category), the default embedded emissions are:
  - Direct emissions: 1.29 t CO_2e per tonne of fertilizer
  - Indirect emissions: 0.11 t CO_2e per tonne
  - Total: 1.40 t CO_2e per tonne taxation-customs.ec.europa.eu+12taxation-customs.ec.europa.eu+12taxation-customs.ec.europa.eu+12
- There's a specific sub-category (CN 3105 90 "Other" fertilizers) with slightly lower defaults:
  - Direct: 0.94 t CO_2e/t
  - Indirect: 0.08 t CO_2e/t
  - Total: 1.02 t CO_2e/t taxation-customs.ec.europa.eu

Fertilizer Category	Direct (t CO_2e/t)	Indirect (t CO_2e/t)	Total (t CO_2e/t)
General fertilizers (CN)	2.32	0.07	**2.39**
"Other" fertilizers (CN 3105 90)	1.23	0.11	**1.35**

Source: Regulation (EU) 2023/956

Additionally, according to current CBAM procedures, both direct and indirect emissions generated during the production process must be calculated. The European Parliament has approved emission coefficients for each product group in accordance with their respective HS codes.

Product	Export value in $	Volume in tn	Total (t CO_2e/t) for category 310230 2.39	CBAM Cost average USD 74	Cost of CBAM to product price
Ammonium nitrate, whether or not in aqueous solution (3102 30)	$ 71,189,000.00	129,997.58	310,694.22	$ 22,991,372.60	32%
Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium (3105 20)	$ 17,070,800.00	39,737.89	53,646.15	$ 3,969,815.14	23%
Total	**$ 88,259,800.00**	**169,735.47**	**364,340.37**	**$ 26,961,187.75**	**31%**

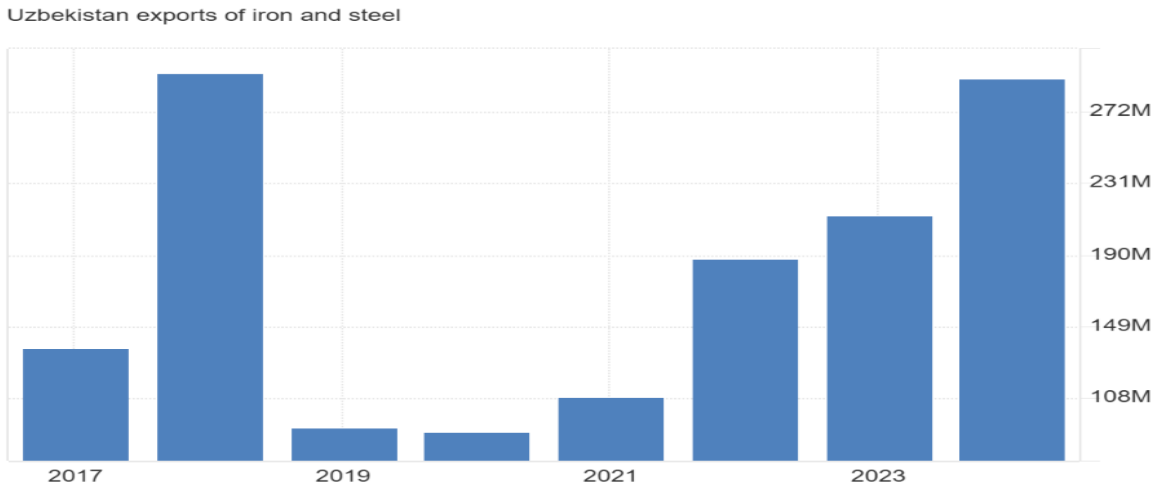
Source: author's calculations

From the above analysis and calculations, it is clear that the impact of CBAM is significant under this methodology. In other words, importers will be required to

pay an additional USD 27 million. It will have a noticeable financial impact on Uzbekistan's fertilizer exports. Together, exports of ammonium nitrate and NPK fertilizers total around $88.26 million. However, when the carbon cost is factored in—based on an average CBAM price of $74 per ton of CO_2 emitted—the additional cost amounts to about $26.96 million. That's nearly one-third (31%) of the total export value. Ammonium nitrate (HS code 310230) is hit the hardest, with a CBAM cost of roughly $22.99 million—about 32% of its value. For NPK fertilizers (HS code 310520), the cost is lower in both absolute and relative terms—around $3.97 million, or 23% of the product's value.

Steel Sector

Steel Exports to the EU emerged around 2022–2023 due to EU sanctions on Russian steel. EU share peaked at 10–12%, declined in 2024. Prices in EU dropped, suggesting a shift in the composition of exported goods.



Source: tradingeconomics.com

Carbon Intensity of Steel Sector depend on energy use, type of energy, and process emissions. Data on sectoral emissions is limited. However, energy mix suggests carbon intensity is comparable to average EU exporters.

Screws Category	Direct (t CO_2e/t)	Indirect (t CO_2e/t)	Total (t CO_2e/t)
Actual calculation 73181100	2.135	0.724	2.858
Default value for 73181100	1,89	0,32	2,21

Source: Regulation (EU) 2023/956

Based on the above information, if we estimate the export value of CBAM-covered products at around $4 million, we can arrive at the following approximate calculation. Assuming an average import price of $2,154 per ton based on 2023 EU import data, this would correspond to an export volume of approximately 1,850 tons. It is important to note that this is a rough estimate.

Product	Export value in $	Volume in tn	Total (t CO_2e/t) for category 73181100	CBAM Cost average USD 74	Cost of CBAM to product price
Screws (Default value for 2.21)	$ 4,000,000.00	1,850.00	4,088.50	$ 302,549.00	8%
Screws (Actual value for 2.858)	$ 4,000,000.00	1,850.00	5,287.30	$ 391,260.20	10%

Source: author's calculations

The export of screws (HS code 73181100) with a total value of $4 million and a volume of 1,850 tons results in a notable CBAM-related cost. Based on two different carbon intensity values:

- Using the default emissions factor (2.21 tCO_2e/t):

  The CBAM cost is approximately $302,549, accounting for 8% of the product's export value.

- Using the actual emissions factor (2.858 tCO_2e/t):

The CBAM cost rises to about $391,260, making up 10% of the export value.

This shows that more accurate emissions data can significantly increase the financial burden under CBAM, emphasizing the importance of emission reduction and accurate reporting.

Microeconomic Analysis and the Process of Implementing CBAM for Uzbek Exporters

A micro-level analysis of the CBAM effect has been conducted for Ammonium nitrate, whether or not in aqueous solution (HS code 3102.30), given the importance of this product.

This product accounts for more than 70% of CBAM-covered exports. Most of it is exported by JSC Navoiyazot and JSC Maxam Chirchiq. Macroanalysis of CBAM effect helps to learn possible challenges and opportunities for companies in introducing a new mechanism. However, due to data limitations, it was not possible to analyze each company separately.

Profitability Analysis

Parameter	Value
Export volume	129,997.08 tons
Export value	$71,189,000
Export price without CBAM	$547.62/ton
CO_2 intensity	2.39 tCO_2e/ton
CBAM price ($74/$tCO_2e$)	$176.86/ton
EU import price with CBAM	$724.48/ton
Local price	$190.00/ton
Delivery cost	$220.00/ton

Source: author's calculations

Where:

Export value – according to the materials The Center of Green Economy Projects under Ministry of Economy and Finance.

Export price without CBAM – source: Web site: (https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2023/tradeflow/Exports/partner/WLD/product/310230)

CO_2 intensity 2.39 tCO_2e/ton – source: European Commission Directorate-General Taxation and Customs Union.

CBAM price ($74/$tCO_2e$) – website: statista.com

Delivery cost $220.00/ton – this in an approximate calculation considering local price plus logistics

Profitability Per Ton

Metric	Formula	Value
Profit without CBAM	$547.62 – $220.00	$327.62/ton
Profit with CBAM	$724.48 – $220 – $176.86	$327.62 – $176.86 = $150.76/ton
CBAM-induced margin loss	$327.62 – $150.76	$176.86/ton (–54%)

Source: author's calculations

Total Profit Scenarios

A. Without CBAM

$$129{,}997.08 \times 327.62 = \$42{,}603{,}176.67$$

B. With CBAM (if it is compensated by exporters)

$$129{,}997.08 \times 150.76 = \$19{,}607{,}760.76$$

C. Total CBAM Loss

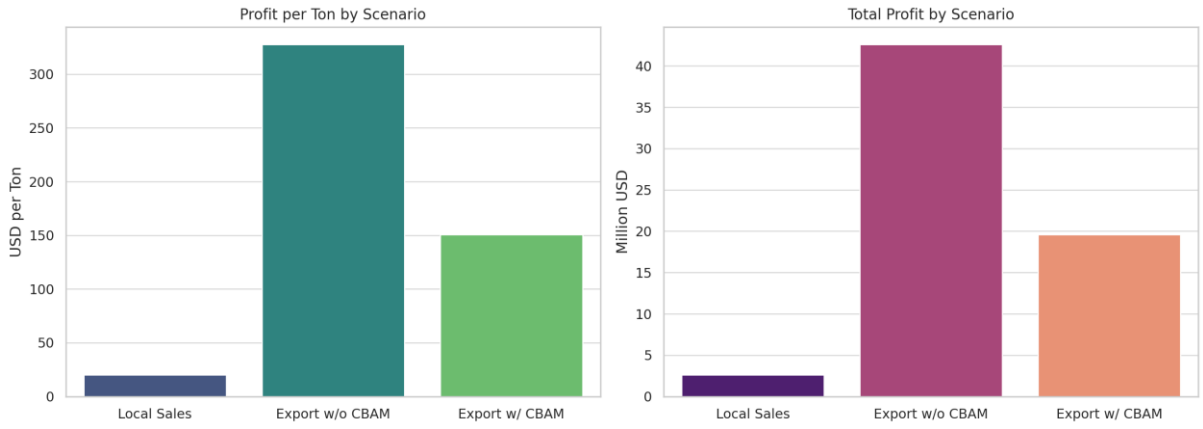
$$\$42{,}603{,}176.67 - \$19{,}607{,}760.76 = \$22{,}995{,}415.91$$

Source: author's calculations

Local Market Comparison

Scenario	Revenue/ton	Margin
Local price	$190	$190 – $170 = $20/ton
Exports with CBAM	$150.76 margin	7.5× more profitable than local sales
Export without CBAM	$327.62 margin	~16× more profitable than local sales

Source: author's calculations



Source: author's calculations

Substitution and Production Decisions

Firms may shift production to lower-emission methods or restructure supply chains to maintain market access. Investment in cleaner technology may become more attractive if it reduces CBAM costs and preserves long-term competitiveness.

Firms might start internal carbon accounting to optimize CBAM declarations. Some may delay or limit EU exports and look to alternative markets if costs outweigh benefits.

CBAM cuts profit per ton by 54%, costing nearly $23 million overall.

Exporting is still much more profitable than selling locally, even after CBAM.

However, the long-term sustainability of profit depends on:

- Reducing emissions (to cut CBAM cost),
- Passing CBAM to buyers,
- Or lobbying for a carbon pricing system in Uzbekistan to claim CBAM deductions.

SECTION 5: ENVIRONMENTAL IMPACT

The primary goal of establishing the CBAM mechanism is to reduce the environmental impact of production. It operates on the principle that the more harmful emissions a company produces, the more it has to pay. In the context of Uzbekistan, the scale of CBAM is relatively limited, accounting for only about 0.32% of the country's total exports. Moreover, the number of enterprises exporting CBAM-covered products is quite small.

Nevertheless, the implementation of CBAM compels producers to start thinking about their environmental impact. They are required to submit quarterly reports that quantify the extent of environmental harm caused by their operations. In this way, environmental damage becomes a measurable factor. As a result, companies are encouraged to become more efficient, focus on resource optimization, and adopt more sustainable practices.

One of the key environmental challenges Uzbekistan faces is the absence of a strong and reliable system for monitoring, reporting, and verifying (MRV) greenhouse gas emissions in line with EU standards. Without such a system, it becomes difficult to measure actual emissions accurately, which means companies often have to rely on default CBAM values—usually less favorable—and miss the opportunity to showcase real progress in reducing emissions.

The below table gives greenhouse gas (GHG) emissions for production of the chosen Uzbekistan exports to the European Union. They fall under the EU's Carbon Border Adjustment Mechanism (CBAM), which adds a carbon cost to imports based on their emissions footprint.

Product	Export Volume (tons)	Emission Factor (tCO_2e/ton)	Total Emissions (tCO_2e)
Ammonium Nitrate (HS 3102 30)	129,997.58	2.39	310,694.22
NPK Fertilizers (HS 3105 20)	39,737.89	1.35 *(estimated)*	53,646.15
Screws – Default EF (HS 7318 1100)	1,850.00	2.21	4,088.50
Screws – Actual EF (HS 7318 1100)	1,850.00	2.86	5,287.30

Total Estimated Emissions from Exported Goods: 373,716.17 tCO_2e

Source: author's calculations

Fertilizer products (especially ammonium nitrate) are the dominant contributors, accounting for over 83% of total emissions under CBAM-covered exports.

Industrial products like screws, though lower in total volume, carry high carbon intensity per ton, which makes them strategically important for decarbonization despite their smaller share in trade. Emission of 373,716 tCO_2e annually for the cargo to EU is equivalent to Greenhouse gas emissions from ~80,000 passenger gasoline vehicles burning over 160 million liters of gasoline.

As mentioned earlier, the data are calculated based on the default value data due to lack of information of CO2 calculation per product.

CBAM primarily assigns a monetary value to the CO2 emissions generated during production. Enterprises not only pay for electricity and other raw materials used in the manufacturing process, but the emissions resulting from their use also affect the final sale price of the product. This, in turn, encourages companies to adopt energy-efficient and efficient production technologies.

The application of the CBAM mechanism helps assess both the physical volume of environmental damage caused by production and its monetary value. Through this assessment, it creates a basis for improving the technical condition of enterprises and encourages them to adopt technologies that cause less harm to the environment.

In this regard, building up MRV capacity would not only help Uzbekistan provide more accurate data but also strengthen its ability to meet its climate goals under the Paris Agreement. Moreover, it would bring greater transparency and accountability to the country's overall approach to climate policy and environmental governance.

Starting from 2026, it is planned to implement similar measures—such as the greenhouse gas inventory conducted at Navoiyazot JSC and Maxam-Chirchiq JSC—across other enterprises in the sector.

SECTION 6: RESULTS AND DISCUSSION

The study focused on certain export products that fall within CBAM — mainly fertilizers like ammonium nitrate and NPK, as well as metal products like screws. The products are not just important to the Uzbek economy, but they're also relatively carbon-intensive, so they're more exposed under the new regime in the EU.

Fertilizers: With a combined export value of around $88.3 million, these products can have a CBAM-related cost of $27.6 million, or roughly 31% of their total worth.

Ammonium nitrate itself can have a 32% CBAM cost over its cost. The fertilizers are less affected, with an effect of 23%.

A moderate-sized but still important export. On a value of around $4 million, CBAM charges will be between $302,000 and $391,000 depending on the default or actual reporting of exporters. That's around 8–10% of the product value.

These are based on 2023 mean EU carbon price of $74 per ton CO_2 emitted. While estimates, these give a clear picture of the cost CBAM will be placing upon exporters.

Fertilizer Exporters: A Wake-Up Call

The fertilizer industry is clearly facing a major challenge. These products are emissions-heavy, and under CBAM, that translates directly into added costs. A third of their export value being eaten up by carbon charges is not sustainable in the long term. Unless companies invest in cleaner technologies or more efficient processes, they risk losing their foothold in the EU market.

Metal Product Exporters: Data Matters

For exporters of screws and similar products, the data shows that **actual emissions reporting** can make a difference. Using accurate data instead of default EU estimates can either increase or reduce CBAM payments. This means firms that measure and manage their emissions carefully could end up saving money — and gaining a reputation as responsible, modern suppliers.

Trade and Market Access

CBAM is more than just a climate policy — it’s changing the rules of international trade. For Uzbek exporters, it means competing not just on quality or price, but also on carbon efficiency. If emissions stay high, products may become too expensive for EU buyers. Some exporters might even shift to markets where carbon isn’t priced — but that limits growth potential in the long run.

A Readiness Gap

Right now, Uzbekistan doesn’t have a carbon pricing system or a national platform to help companies track and report their emissions in a way that meets

EU standards. This puts our businesses at a disadvantage. Without government support, training, and investment in monitoring systems, many exporters simply won't be able to keep up.

An Opportunity in Disguise

That said, CBAM could also be a chance to modernize. By upgrading technologies, improving efficiency, and becoming more climate-friendly, Uzbek firms could:

- Avoid CBAM costs,
- Access green financing,
- Build stronger relationships with EU partners, and
- Future-proof their businesses for a low-carbon economy.

Those who start adapting early could end up with a real competitive advantage. It's important to be clear about what this analysis can and can't tell us. These are approximate calculations based on available trade data, average carbon prices, and emissions estimates. Actual CBAM payments will depend on firm-level data, which wasn't available. Prices could also rise or fall in the future, and the EU may change how CBAM works as it gets implemented fully after 2025.

Even so, the results highlight the very real financial risks ahead — and the urgent need for both policy and business responses.

FINAL SECTION: CONCLUSIONS AND RECOMMENDATIONS

The research focused on some of the most important export products that come within CBAM - basically, fertilizers like ammonium nitrate and metal products like screws.

Not only are these products important to the Uzbek economy, but they also have quite high carbon intensities, so they're more vulnerable under the new EU regulation.

Fertilizers: With a collective value for export of nearly $88.3 million, the

products can have a CBAM expense of $27.5 million, or some 31% of their collective value.

Ammonium nitrate alone can have a 34% CBAM cost compared to its price. The fertilizers are a bit less Based on this research, the policy of establishing the European Union's Carbon Border Adjustment Mechanism (CBAM) would be a significant shift in international trade and climate policy. This study analyzed how CBAM would economically and environmentally impact Uzbekistan as a country with limited but significant export connections to the EU in sectors such as fertilizers and metal products.

The quantitative assessment found that although aggregate exposure to CBAM is relatively low at the moment—approximately 0.32% of the nation's overall exports—the impact on specific goods and enterprises is significant. For example, fertilizer exports can be subject to a CBAM-related cost of up to 31% of export value, and even relatively smaller exports like screws can see their cost increase by 8–10%, depending on emissions reporting.

Environmentally, CBAM exerts pressure and also opportunity.

It sensitizes exporters to their carbon burden and compels industries to adopt cleaner technology and energy. One of the big issue, however, remains that there is no robust emissions Monitoring, Reporting, and Verification (MRV) mechanism. In the absence of these mechanisms, exporters are able to with default estimates of emissions and be at a cost disadvantage.

They are calculated from 2023's EU average carbon price of $74 per ton CO_2 emissions. They may be estimates, but they give us a fair estimate of the cost of burden that CBAM will impose on exporters.

RECOMMENDATIONS:

Establish a National MRV Framework

An entire MRV system being in place, aligned with EU level standards, is critical. This will allow Uzbekistan to provide verifiable emissions information, reduce the use of default values of CBAM, and allow exporters to highlight their actual environmental performance.

Promote Industry Transition towards Green Energy

Government incentives and public-private partnerships have to be created to incentivize large exporters to switch to green power. Pilot ventures with companies like Navoiyazot can serve as replicable models for solar and wind integration.

Raise Awareness and Build Capacity

A majority of companies are ignorant of the implications of CBAM. Capacity-building programs, technical workshops, and targeted outreach—especially for SMEs—will play a key role in enabling adaptation by industries.

Leverage CBAM as a Development Opportunity

As much as CBAM has compliance challenges, it also presents opportunities for modernization, investment, and innovation. Uzbekistan can leverage this opportunity to solidify its place within clean global value chains and mobilize green finance.

Coordination with National Climate Goals

CBAM compliance must be coordinated with overarching climate policies, including the Nationally Determined Contributions (NDCs) of Uzbekistan. This will help align trade, industry, and climate goals.

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